National Institute of Environmental Health Sciences

Spatio-temporal variability of NDVI-precipitation over southernmost South America: Possible linkages between climate signals and epidemics

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Abstract:

Climate-environment variability affects the rates of incidence of vector-borne and zoonotic diseases and is possibly associated with epidemics outbreaks. Over southernmost South America the joint spatio-temporal evolution of climate-environment is analyzed for the 1982-2004 period. Detailed mapping of normalized difference vegetation index (NDVI) and rainfall variability are then compared to zones with preliminary epidemiological reports. A significant quasi-biennial signal (2.2- to 2.4-year periods, or QB) for joint NDVI-rainfall variability is revealed. From rotated EOFs, dominant NDVI patterns are partitioned according to their lead frequencies: (1) the 'QB group' (2.1- to 3-year periods) includes six modes over southern Brazil, Uruguay, northern-central Argentina (two modes), the southern Paraguay-northern Argentina border, and the Santa Cruz Province; (2) the QB1 (2.4- to 3-year periods) + quasi-quadrennial (QQ) mode over the Misiones Province; and (3) the QB2 (2.1- to 2.5-year periods) + QQ + inter-annual (IA) (3- to 7-year periods) two modes over south-eastern Argentina. Modes within the 'QB group' are positively correlated with global climate signals and SST. The Uruguayan mode is correlated with global ENSO (8-month lag) whilst the southern Entre-Rios/northern Buenos Aires provinces are correlated with central equatorial Pacific SSTs (3-month lag). The Santa Cruz (Patagonia) Province is most correlated with the Pacific South America (PSA) index and SST patterns (3-month lag) along the Antarctica circumpolar current. The spatial distribution of lead NDVI modes includes the Formosa, Misiones, Chaco and Buenos Aires provinces among others, known for being prone to vector-borne epidemics such as dengue fever, malaria, leishmaniasis (American cutaneous leishmaniasis or ACL), hantivirus, chagas and Argentine hemorrhagic fever (AHF). Some provinces also correspond to regions where lead NDVI PCs' modes are associated with high-frequency climate signals such as the quasi-biennial oscillation in northwest Argentina. The joint preliminary results (climate-environment-public health reports) presented here for the first time are meant: (1) to contribute to a better understanding of climate-environment-epidemics process-based and modeling studies and (2) to facilitate, in the long run, the implementation of local and regional health early warning systems (HEWS) over southernmost South America. The latter is becoming crucial with ever-increasing migration, urban sprawl (re-emergence of dengue fever epidemics since the late 1990s), all embedded in a climate change context.

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Resource Description

Communication: ☒

resource focus on research or methods on how to communicate or frame issues on climate change;

surveys of attitudes, knowledge, beliefs about climate change

A focus of content

Communication Audience: ☑

audience to whom the resource is directed

Policymaker

Early Warning System: ☑

resource focus on systems used to warn populations of high temperatures, extreme weather, or other elements of climate change to prevent harm to health

A focus of content

Exposure : ☑

weather or climate related pathway by which climate change affects health

Ecosystem Changes, Precipitation

Geographic Feature: ☑

resource focuses on specific type of geography

Urban

Geographic Location: ☑

resource focuses on specific location

Non-United States

Non-United States: Central/South America

Health Impact: ☑

specification of health effect or disease related to climate change exposure

Infectious Disease

Infectious Disease: Vectorborne Disease, Zoonotic Disease

Vectorborne Disease: Fly-borne Disease, Mosquito-borne Disease

Fly-borne Disease: Leishmaniasis, Trypanosomiasis

Mosquito-borne Disease: Dengue, Malaria

Zoonotic Disease: Hantavirus Pulmonary Syndrome, Other Zoonotic Disease

Zoonotic Disease (other): Argentine hemorrhagic fever

Mitigation/Adaptation: ☑

mitigation or adaptation strategy is a focus of resource

Adaptation

Resource Type: ☑

format or standard characteristic of resource

Research Article

Timescale:

time period studied

Time Scale Unspecified

Vulnerability/Impact Assessment:

resource focus on process of identifying, quantifying, and prioritizing vulnerabilities in a system

A focus of content